<u>IN THE SPECIFICATION</u>:

Please amend the specification as follows:

Please substitute the paragraph beginning at page 1, line 12, with the following.

-- In an exposure apparatus for manufacturing, e.g., semiconductor devices that are increasingly shrinking in their feature sizes, before a reticle pattern is projected ~~on~~ <u>onto</u> a wafer by exposure, the wafer and reticle are aligned. --

Please substitute the paragraph beginning at page 2, line 5, with the following.

-- Pre-alignment requires detection in a very wide range because the wafer feed shift generated when the conveyor apparatus feeds a wafer onto the chuck is detected, as described above. The detection range is generally about 500 μm ~~squared~~ <u>square</u>. As a method of detecting the X- and Y-coordinates of one mark and performing pre-alignment, pattern matching is often used. --

Please substitute the paragraph beginning at page 3, line 12, with the following.

-- A problem associated with pre-alignment mark detection will be described with reference to Figs. 6A to 6H. Fig. 6A shows a layout in which a semiconductor element pattern is adjacent outside a cross-shaped mark 100, in which a portion ~~win~~ <u>"win"</u> long in the horizontal direction is a signal detection region. Figs. 6B and 6D show detection signal waveforms, and Figs. 6C and 6E show the wafer sectional structures corresponding to the signals shown in Figs.

6B and 6D. Fig. 6F also shows the cross-shaped detection mark 100. Fig. 6G shows the detection signal waveform. Fig. 6H shows the wafer section structure corresponding to Fig. 6G. --

Please substitute the paragraph beginning at page 4, line 14, with the following.

-- The examples shown in Figs. 6A to 6H suggest that along with the progress in techniques of manufacturing a semiconductor device with high density, processes that make detection of a pre-alignment mark present in a wide detection range by the conventional pattern matching hard have emerged and they present problem problems. --

Please substitute the paragraph beginning at page 4, line 20, and ending on page 5, line 6, with the following.

-- For example, a shown in Fig. 6E, when the mark has a small step difference, although the peripheral pattern has a large step and high reflectivity, an image signal shown in Fig. 6D is obtained. The image signal shown in Fig. 6D is a signal in the region win "win" shown in Fig. 6A, which is obtained by sensing the pre-alignment mark 100 irradiated by dark field illumination. The ordinate represents a video signal voltage, and the abscissa represents a coordinate. When the signal is binarized using a predetermined threshold value, the mark disappears because the signal level of the mark portion is low. For this reason, the mark cannot be recognized by template matching. -

Please substitute the paragraph beginning at page 5, line 15, with the following.

-- Various approximation calculations have also been examined to solve the above problem. However, the problem of a low detection rate for a low-contrast image remains unsolved. --

Please substitute the paragraph beginning at page 6, line 2, with the following.

-- In the vector correlation method, a high-contrast mark and low-contrast mark cannot be detected using the same parameter in extracting the edge information of the marks. Hence, the edge extraction parameter ~~need~~ needs to be tuned. --

Please substitute the paragraph beginning at page 6, line 8, with the following.

-- The present invention has been made in consideration of the above situation, and has as its object to stably detect the position of a mark even in a mark image that is difficult to detect, e.g., a low-contrast mark image, a noisy mark image, or a mark image whose mark has a defect generated in the wafer process. Especially in association with the vector correlation method, it is another object of the present invention to optimize a mark detection method in accordance with a mark image in extracting information related to an edge and to stably detect the mark position and, more specifically, to cope with any mark image by self learning and to stably detect the mark position. --

Please substitute the paragraph beginning at page 6, line 20, and ending on page 7, line 12, with the following.

A10 -- According to the first aspect of the present invention, there is provided a position detection apparatus for detecting a position of a mark on an object, comprising an extraction section for observing the mark and extracting a plurality of edge information data of the mark in correspondence with attribute information representing features of the edge information, respectively, a position determination section for comparing each edge information with one of a plurality of templates, which is specified by attribute information corresponding to the edge information and evaluating a plurality of comparison results obtained by comparison to determine the position of the mark, and a control section for changing at least one of an extraction rule in the extraction section and an evaluation rule in the position determination section on the basis of the plurality of comparison results by the position determination section and causing the extraction section and the position determination section to execute processing again. --

Please substitute the paragraph beginning at page 7, line 13, with the following.

A11 -- In the position detection apparatus according to the first aspect of the present invention, each attribute information data preferably represents an edge portion of the mark, which is associated with the corresponding edge information. In addition, each attribute information data preferably represents one of a plurality of extraction conditions under which the corresponding edge information is extracted. --

Please substitute the paragraph beginning at page 7, line 21, ending on page 8, line 4, with the following.

AM2 -- In the position detection apparatus according to the first aspect of the present invention, preferably, the extraction section extracts, as each edge information data, information representing an edge position shifted from an actual edge position of the mark by a predetermined distance in one of a plurality of predetermined directions, and each attribute information data represents a direction in which an edge position associated with the corresponding edge information is shifted from the actual edge position of the mark by the predetermined distance. --

Please substitute the paragraph beginning at page 8, line 13, with the following.

AM3 -- Preferably, the differential processing section calculates a change rate of an image signal of the mark image along at least two directions of the mark image, and each attribute information data is associated with one of the at least two directions. --

Please substitute the paragraph beginning at page 8, line 18, with the following.

AM4 -- Alternatively, each attribute information data is preferably associated with a sign of the differential result by the differential processing section. --

Please substitute the paragraph beginning at page 8, line 21, and ending on page 9, line 1, with the following.

-- Alternatively, preferably, the differential processing section calculates a change rate of an image signal of the mark image across the mark image along row and column directions of the mark image, and each attribute information data is associated with one of the row and column directions and the differential result by the differential processing section. --

Please substitute the paragraph beginning at page 10, line 13, and ending on page 11, line 11, with the following.

-- According to the third aspect of the present invention, there is provided an exposure apparatus comprising a projection optical system for projecting a pattern onto a substrate, a chuck on which the substrate is placed, and a position detection section for detecting a position of a mark on the substrate placed on the chuck, wherein the substrate is aligned on the basis of a detection result by the position detection section, and then, the substrate is exposed using the pattern, and position detection section comprising an extraction section for observing the mark and extracting a plurality of edge information data of the mark in correspondence with attribute information representing features of the edge information, respectively, a position determination section for comparing each edge information data with one of a plurality of templates, which is specified by attribute information corresponding to the edge information and evaluating a plurality of comparison results obtained by comparison to determine the position of the mark, and a control section for changing at least one of an extraction rule in the extraction section and

8

an evaluation rule in the position determination section on the basis of the plurality of

comparison results by the position determination section and causing the extraction section and

the position determination section to execute processing again. --

Please substitute the paragraph beginning at page 12, line 11, and ending on page 13, line

2, with the following.

-- According to the fifth aspect of the present invention, there is provided a position

detection method of detecting a position of a mark on an object, comprising the extraction step of

observing the mark and extracting a plurality of edge information data of the mark in

correspondence with attribute information representing features of the edge information,

respectively, the position determination step of comparing each edge information data with one

of a plurality of templates, which is specified by attribute information corresponding to the edge

information and evaluating a plurality of comparison results obtained by comparison to

determine the position of the mark, and the control step of changing at least one of an extraction

rule in the extraction step and an evaluation rule in the position determination step on the basis of

the plurality of comparison results in the position determination step and causing the extraction

step and the position determination step to execute processing again. --

Please substitute the paragraph beginning at page 18, line 18, with the following.

-- It is determined in step S102 whether the mark position search is successful. More

specifically, when the matching result (maximum degree of matching) has a value equal to or

larger than a threshold value for detection determination, it is determined that mark position

detection is successful, and the position of the mark is precisely measured in step S103. --

Please substitute the paragraph beginning at page 19, line 8, with the following.

-- If mark position search fails, the flow advances the loop including step S104 to change

parameters for detection, i.e., to adjust one or both of the edge extraction processing parameter

and the threshold value for detection determination, and edge extraction (S100), mark position

search (S101), and detection determination (S102) are performed again. The repetitive loop of

parameter change and search is controlled on the basis of the number of times or conditions set in

advance. If it is determined that the mark position cannot be accurately detected any more even

by repeating the repetitive loop, a detection error occurs. --

Please substitute the paragraph beginning at page 22, line 22, and ending on page 23, line

12, with the following.

-- Matching calculation in a mark image search is performed by determining whether,

e.g., the pieces of edge information shown in Fig. 4B are present at the positions of open circles

in Fig. 5B with reference to the mark center (cross). In a similar way, Fig. 4C and Fig. 5C, Fig.

4D and Fig. 5D, Fig. 4E and Fig. 5E are compared to ~~determined~~ determine whether the pieces of

edge information shown in Figs. 4C to 4E are present at the position of open circles in Figs. 5C

to 5E, respectively. When the edge information are present at all the hollow bullet positions, the

degree of matching is 100%. If some hollow bullet positions have no edge information, the

degree of matching is lower than 100%. The above matching calculation is performed for the entire edge images while changing the mark center coordinates, and mark center coordinates at which the degree of matching is highest are finally extracted, thereby completing the search. --

Please substitute the paragraph beginning at page 23, line 26, and ending on page 24, line 8, with the following.

-- When the maximum degree of matching obtained by the above-described search is lower than the level of threshold value for determination, the coordinates at which the maximum degree of matching is obtained may not indicate the correct mark position. In this case, edge information extraction may not be optimum. Hence, preferably, the threshold values thl, thr, thu, and tho used for extraction of mark edge information are corrected, the edge information data are generated again, and the search is repeated. --

Please substitute the paragraph beginning at page 24, line 9, with the following.

-- For example, when the threshold values thl, thr, thu, and tho for edge information is obtained from a low-contrast mark image. Hence, the degree of matching in the search is low, and mark detection determination is impossible. Preferably, the edge information of the mark is detected while gradually decreasing the threshold value for edge extraction. This makes it possible to obtain a sufficient degree of matching in the search. --

Please substitute the paragraph beginning at page 25, line 6, with the following.

-- For precise detection (S103) after the end of the mark image search, the mark position can be determined at an accuracy beyond the pixel resolution by, e.g., a method of obtaining the barycenter on the basis of the luminance distribution with an origin set at the center coordinates of the A/D-converted image found by the search. --

Please substitute the paragraph beginning at page 25, line 12, with the following.

-- In this embodiment, edge extraction is performed immediately after image reception. Processing of performing noise removal filtering before edge extraction to lower the noise level in advance and prevent any unnecessary edge information, or forming a bold line image as edge information to correct deformation in mark size or omission of edges is also effective. Addition of the above processing results in an increase in detection rate in the mark search. --

Please substitute the paragraph beginning at page 25, line 23, and ending on page 26, line 2, with the following.

-- In the first embodiment, the position detection apparatus of the present invention and the semiconductor exposure apparatus using the position detection apparatus are applied to pre-alignment using the off-axis scope 6. However, the process of the mark position search is not limited to pre-alignment using off-axis. --

Please substitute the paragraph beginning at page 26, line 23, with the following.

-- In reticle alignment for alignment of the reticle 1 with respect to a projecting lens 2 as

well, the same processing as in the first embodiment can be performed for a mark search. --